river of the same name, having arrived at the town of Yakutsk on September 22.

DR. GERHARD ROHLFS had finally fixed his departure from Malta for the 20th instant. He will be accompanied by two Austrian travellers, Dr. Hecker, and Herr von Csillagh. The party will first go to Tripolis, and direct their principal efforts to the investigation of the Shari River, and of the sources of the Binue and Congo Rivers.

CAPT. TYSON, having arrived at St. John's, Newfoundland, has sent a telegram to Washington stating that his voyage has been quite successful, and every part of the task imposed upon him has been accomplished. Capt. Tyson learns with deep regret that all has been rendered useless by the postponement of the definitive expedition.

ON reference to a map of China lately published by Mr. Stanford for the China Inland Mission, it will be seen that the missionaries of that body have for some years past been emulating their Roman Catholic brethren in the energy with which they have pushed their way into various parts of the empire. One of the most remarkable journeys, an account of which has but lately become available, was performed principally on foot, by Mr. John McCarthy, who left Shanghai in December, 1876, and reached Bhamô on August 26, 1877, having travelled a distance, including detours, of about 3,000 miles. Mr. McCarthy, though taking a somewhat different course, made the same journey as the Grosvenor Mission, and he claims to be the first non-official traveller who has thus traversed the entire width of the empire, and crossed the Kah-chen hills to Bhamô. Wearing the Chinese dress, and having nothing strange or novel with him, he was able to move along without any difficulty through the various towns and cities, and it is certainly worthy of note that throughout the whole of his long and hazardous journey he was not once obliged to appeal to an officer for help of any kind, and in no case did any officer put an obstacle in his way. The country, as far as the great commercial mart of Chungking, in Szechuen, is now comparatively so well known, that that part of Mr. McCarthy's journey was tolerably easy, but after leaving Chungking the case is different. Circumstances induced him to make for Kweiyung-fu, the capital of Kweichow; he found that the country due south of Chungking was not at all to be compared with the eastern portion of Szechuen, large tracts of land being uncultivated, towns fewer, the people more scattered, and worse housed and clothed. It would be difficult, he says, to picture the desolation of a great part of the Kweichow province; in consequence of the many years' internal strife, whole districts having been entirely depopulated. After a fortnight's stay in Kweiyang-fu Mr. McCarthy decided to walk westward, as far, at least, as Yünnan-fu, being anxious to test the feelings of the people towards foreigners. The people everywhere continued civil, and no more difficulties were met with in Yünnan than in previous portions of the journey. On the road between Yünnan-fu and Tali-fu Mr. McCarthy remarks that "the people generally are in a deplorable condition: the women compelled to do manual labour, which in other places is confined entirely to men. Men and women—but especially the latter—suffer from the formation of goitre, some of immense size." From Tali-fu to Têng-yüeh, or Momien, Mr. McCarthy says, is really the most fertile part of the country. Yungchang-fu, between these places, has been a fine city, and even now the southern part is well built over, and a good deal of business is done there. Mr. McCarthy found that the fame of the medical work at Bhamô had spread even to Momien, and during the four days' walk to Manwyne he met many Shans and Chinese who spoke approvingly of the wonderful cures effected by the foreign teachers. Having secured the services of a chieftain he crossed the hills in two days, and arrived at Bhamô in safety. This Kah-chen chief and his followers professed the greatest friendship for the English, and treated Mr. McCarthy so well that he agreed to return with him in a fortnight, in order to continue his journeys in Yünnan. This plan, however, he was obliged to give up, as he was informed by our political agent at Bhamô that he could not be allowed to re-enter China from Burmah, that being forbidden by the Indian government!

THE Wesleyan Missionary Society have recently received some very satisfactory intelligence in regard to the attitude of the natives towards foreigners in a part of Central China where they had probably never been seen before. Writing from Kwang Chi, Hankow, under date of June 7, the Rev. Thos. Bramfit says, in describing a missionary tour, that, "as Lo Tien, Ma Tsien, and the other towns have not been visited before, the people came out in crowds to see the foreigner, and to hear his doctrine; and it is to be recorded to their credit that without exception they treated us kindly, and seem inclined to give the truth a fair hearing. It may be that the Chefoo Convention has something to do with the change in the temper of the people, as compared with that in other places when first visited; but it struck us that the change is to be accounted for chiefly by the increased intercourse between the people and foreigners."

THE French Government have sent M. Léon Cahun, well known from his researches in Eastern Europe and in Central Asia, to Cyprus, on a special mission, in order to investigate the island in an anthropological and archæological direction.

NOTES

THE death is announced, on the 13th inst., of M. Delafosse, Professor of Mineralogy in the Paris Museum of Natural History and the Faculty of Science.

WE have received a "first proof" of the list of awards made to British exhibitors, from which we cull the following items:—A Grand Prix and Diplôme d'honneur have been awarded, in Class 8, Organisation, Methods and Appliances for Superior Instruction, to South Kensington; in Class 15, Mathematics and Philosophical Instruments, gold medals have been awarded to Mr. J. H. G. Dallmeyer, Mr. Howard Grubb, Messrs. A. Léqé and Co., Messrs. Negretti and Zambra, Messrs. Ross and Co., and Sir William Thomson; in Class 16, Maps and Geographical and Cosmographical Apparatus, a gold medal has been awarded to Mr. Edward Stanford; in Class 65, Telegraphic Apparatus and Processes, a Grand Prix is awarded to Prof. A. Graham Bell, for his magneto-electric telephone, without electric current; in Class 67, Navigation and Life Saving, a gold medal to Sir William Thomson, for his compass.

THE Council of the Meteorological Society have arranged for a course of six lectures on meteorology to be given at the Institution of Civil Engineers, 25, Great George Street, Westminster, on successive Thursday evenings, commencing on the 31st instant at eight o'clock. The first lecture will be by Dr. R. J. Mann, on the "Physical Properties of the Atmosphere." The other lectures will be by J. K. Laughton, F.R.A.S., R. Strachan, F.M.S., Rev. W. Clement Ley, M.A., F.M.S., G. J. Symons, F.R.S., and R. H. Scott, F.R.S. Admission to the lectures will be by ticket only, which may be obtained free on application to the Assistant Secretary at the office of the Society, 30, Great George Street.

IN a lately-issued number of the *Proceedings* of the American Philosophical Society, Prof. Cope has given an account of the collection of fishes made by Prof. Orton at various points on the head-waters of the Amazon. Species of the genera *Belone* and

Tetrodon—characteristically marine forms—are here recorded as having been obtained in these districts 2,500 miles from the mouth of the river—thus showing how far marine animals will penetrate into, and become ultimately acclimatised in, fresh waters.

THE existence of the true heath plant in North America was for a long time considered very doubtful, and its detection in New England some years ago is a matter of much interest. The published localities hitherto are Newfoundland, Nova Scotia, and Massachusetts, but, according to the *Bulletin* of the Torrey Botanical Club, Dr. Hexamer, of Newcastle, has lately found a few plants of it near Egg Harbour, New Jersey.

PROF. MORSE, since his return to Japan, has been diligently engaged in prosecuting investigations into the natural history and archæology of the coast region. During his summer's stay at Yezzo he brought together a large material of the most interesting character, the transmission of a portion of which to American museums, it is hoped, he will be able to bring about.

THE operations of the United States Fish Commission a Gloucester, Massachusetts, were brought to a close, so far as the deep-sea research was concerned, on September 26, on which day the last trip of the United States steamer *Speedwell* was made. This vessel, under the command of Capt. L. A. Beardslee, of the navy, has been diligently occupied since the middle of July in her work, and has made trips of greater or less extent, varying from five to fifty miles, nearly every suitable day during the summer. With an efficient corps of naturalists, consisting of Prof. A. E. Verrill, Mr. Richard Rathbun, and Prof. Sanderson Smith for the marine invertebrates, Dr. W. G. Farlow for the algæ, Prof. G. Brown Goode, Dr. T. H. Bean, and Mr. Earll for the fishes, and Mr. Asaph Hall, Jun., in charge of the temperature observations, very important results have been secured, the location and extent of important fishing banks have been ascertained, and existence established, of many new and important fishes and invertebrates. A full account of these will be published in the annual report of the commission. The existence of species of shark, chimæras, and other strange fishes in the deep water off the coast, has been established by numerous specimens, while the corals, gorgonians, star-fishes, and other invertebrates brought in are of the most interesting character. A portion of the commission has also been engaged during the season in collecting numerous facts in regard to the fisheries of Gloucester, especially those relating to the cod, halibut, and mackerel, the report upon which, when published, will doubtless be considered the first reliable statement of the history of this great industry.

IT is desired to enlist the co-operation of botanists in general, and more especially of bryologists, in a scheme set on foot by the Botanical Locality Record Club for investigating the geographical distribution of mosses in the British Isles. The Botanical Locality Record Club was founded in 1873 for the purpose of working out the distribution of British plants, records, accompanied by specimens as vouchers, being sent in by the members and embodied by the recorder in an annual report on the plan of "topographical botany." The club, which commenced with fifty-four members, now contains nearly 100, including some of our most eminent botanists. A large amount of work has been done by the club during the five years that it has been in existence, the floras of several counties previously almost unexplored have been worked out, and a very large number of additions have been made to the flora of many others. Up to the present time the reports have dealt only with the flowering plants and vascular acrogens. In 1875, however, a suggestion was made that the club should include in its field the other orders of cryptogamia, and it is considered desirable that, if possible, this should be carried into effect. It is proposed to start with the mosses, for which order Mr. C. P. Hobkirk, F.L.S., and Mr. H. Boswell have consented to act as recorders. A list of the mosses hitherto recorded in Great Britain, entitled "The London Catalogue of British Mosses," has been drawn up by Messrs. H. Boswell and C. P. Hobkirk, as an aid to collectors, and to secure uniformity of nomenclature. A number of specimens have already been sent in by several members. At present, however, the funds in hand are not sufficient to allow of the publication of a report on mosses without seriously curtailing the report on the flowering plants, which it is not considered desirable to do, especially seeing that bryologists constitute but a comparatively small proportion of the members of the club. If more botanists interested in mosses (say thirty) could be induced to join the club, the additional subscriptions (5*s.* each per annum) would suffice for the publication of a report on mosses. Botanists wishing to join the club are requested to send their names either to Dr. H. F. Parsons, Goole, or C. P. Hobkirk, Huddersfield.

WE are glad to see that the Metropolitan Board of Works have decided to give the electric light a fair trial by making a large and continued experiment along the Victoria Embankment and perhaps the recently freed Waterloo Bridge. The Commission of Sewers have resolved to try similar experiments on the Holborn Viaduct and in the open space in front of the Royal Exchange and Mansion House. We trust proper discrimination will be exercised in making arrangements, and if the interests of the public are alone considered, we can hardly doubt what will be the result.

Engineering has been publishing an interesting series of articles on physical science at the Paris Exhibition. In an article in the last number on the Jablochkoff system of electric lighting, some figures are given as to the total cost of the light from sixteen Jablochkoff candles, which shows it to amount to 8*s.* 6½*d.* per hour. The light of the sixteen candles is estimated by the Jablochkoff Company as equal to that of 1,600 gas-burners, each consuming 3¾ cubic feet per hour, or about 6,000 cubic feet altogether. The price of gas in Paris being 6*s.* 10*d.* per thousand cubic feet to the public and 3*s.* 5*d.* to the Administration of the Ville de Paris, it follows that the cost of illuminating by gas, equal in power to that produced by the Jablochkoff system for 8*s.* 6½*d.*, would be 2*l.* 1*s.* to the public and 20*s.* 6*d.* to the Ville de Paris, while in London, taking gas at 3*s.* per thousand, its hourly cost would be 18*s.*

CARRIER pigeons, it would seem, are being turned to useful account in a new direction in Germany, for Consul Ward writes to the Foreign Office that the successful results attained by the establishment of communication between the two Eider light-ships and the port of Tönning, in Schleswig, by these means has led to the organisation of a similar arrangement between the light-vessel stationed off the Island of Borkum, at the mouth of the Ems and the island itself, whence any news brought by the pigeons can at once be forwarded by telegraph to the main-land.

SERGEANT JENNINGS, of the Signal Corps of the United States, has established a temporary station in the American section of the International Exhibition, and is practising weather-warning according to the rules of the service, as far as it is possible with his limited knowledge of the peculiarities of the Parisian climate and atmospheric conditions. This has attracted the attention of the public and scientific authorities.

MR. A. CRAIG-CHRISTIE, of Edinburgh, writes to us to say that it occurred to him some little time ago that our common grass, *Molinia cærulea*, might form a good material for paper-making, on account of its tenacity of fibre and the comparatively small quantity of silica in its composition—two characters which distinguish it from all our native grasses. He sent a small quantity of the grass to Mr. Thomas Routledge, of Sunderland, who, after experiment, concludes that, taken as dried and put up carefully in bundles, free from weeds and dirt, its value would be equal to esparto at 5*l.* per ton dry. "I, however," Mr. Routledge states, "must refrain from reporting *positively* as to its value for paper-making from the result of so small an experiment. I should require at least one ton (more would be better) to test it practically and make paper from it. . . It may be worth more than the value I mention, but only a practical working trial into paper can properly test this point." Mr. Christie writes in the hope that some of our landed proprietors may be sufficiently interested in the matter to send Mr. Routledge a quantity of the grass, so as to repeat his experiment on the large scale. The grass grows in the open parts of woods and on moorlands all over Scotland, and could be cultivated where nothing else of any value will grow. As the plant lasts for several years, the only expense after the first outlay would be that of gathering in the crop.

A DESPATCH from Poughkeepsie, dated October 4, gives the particulars of a severe earthquake shock along both sides of the Hudson from Marlborough to Peekskill, a distance of twenty-five miles. The shock was first felt at 2.30 o'clock A.M. at West Point. The shock seemed to come from the north and to pass south. For several seconds the earth seemed to rock, and houses were shaken and windows rattled. The rumbling and shock together lasted half a minute.

IN reference to the article in vol. xviii. p. 620, on the balloon experiments at Woolwich, Mr. Percy Smith writes to remind us of the fact that the first aerial voyage made in England took place on September 14, 1784, when Lunardi ascended from London in a balloon thirty-three feet in diameter, and filled with hydrogen.

M. AMÉDÉE GUILLEMIN, the well-known author of "Le Ciel" and other works on popular astronomy, has been selected by the Liberal-Republican Committee to stand as a candidate in the next elections for the French Senate, for the Department of Saone et Loire. It is stated that a number of scientific men will contend for other vacant seats.

A TELEGRAM from Sydney states that it has now been definitively decided to hold the International Exhibition in August, 1879, as gazetted last February. The Exhibition is being organised under the auspices of the Agricultural Society of New South Wales.

IN connection with the Bristol Museum and Library we have received a syllabus of a course of ten lectures, on literary and scientific subjects, to be delivered in the lecture theatre of the Museum during the winter. The lectures are mostly scientific, and the lecturers men of established eminence in their own departments.

AUSTRIA, Spain, Egypt, China, Morocco, Portugal, Russia, and England, with all her colonies, have presented the French government with all the objects which have been exhibited by them in the ethnographical and pedagogical departments of the exhibition. These invaluable collections will be exhibited in the Ethnographical and Pedagogical Museum, which the French government intends to establish, according to the announcement made by M. Bardoux in one of his last speeches.

THE *Journal Officiel* of the French republic published, on October 19, a decree of the President, appointing a general commission to investigate the means of making the best use of running waters all over France. A systematic inspection will take place. The commission has been divided into the following sections:—1. Irrigation; president, M. Andral. 2. Supply of cities; president, M. Magnin. 3. Creation of reservoirs; president, M. Cocheris. Any person wishing to suggest improvements or useful works is requested to write to the president of the section which his communication concerns. The letters are to be directed to the Ministry of Public Works.

THE number of aeronautical ascents in France is increasing in a most remarkable manner, owing to the splendid working of the Giffard captive balloon. Every Thursday and Sunday two free balloons, inflated with pure hydrogen, have been sent up from the Cour des Tuileries during several weeks. The number is to be enlarged progressively, so that three, four, and at last five mounted balloons will be sent up.

TWO volumes of the *Memoirs* of the Geneva Society of Physics and Natural History have just appeared. The first, forming the second part of vol. xxv. of these *Memoirs*, is occupied entirely by the sixth fascicule of the "Mélanges Orthoptérologiques" of Henri de Saussure, and contains the monograph on the Gryllidæ. The second volume, forming the first part of vol. xxvi. of the *Memoirs*, contains (1) a paper by M. J. E. Duby on new or imperfectly known exotic mosses; (2) a stratigraphical study of the south-west part of the Crimea, by M. Ernest Favre; (3) researches on fecundation among various animals, by M. Hermann Fol.

A FINE elephant tusk was found in the month of August last in a locality near Geneva on a hill to the south-west of the confluence of the Arve and the Rhone. It was taken from a gallery in a very compact sand along with beds of hard and tenacious gravels formed of pebbles bound together by calcareous cement. The part of the tusk which has been extracted is about eighty centimetres long; it is the anterior portion, but the fragments left behind lead to the presumption that its total length exceeded 1·50 m. The bed in which it was found belongs to the old alluvium, several metres below the glacial earth. Prof. Alph. Favre assigns it to the *Elephas antiquus*, of which *débris* were met with in 1786 by H. B. de Saussure in two places in the southern part of the valley of Geneva Lake. A portion of the parenchymatous matter contained in the interior of the tusk has been analysed by Prof. Brun, of the University of Geneva, who, having dissolved it in hydrochloric acid, obtained a residuum of organic particles—charcoal, grains of fecula, spores of algæ and of mushrooms, four species of diatoms still living in the waters of the country, and lastly a polycistina, a silicious form not well determined, and discovered previously in the mud of the Lake of Geneva. From the presence of these Prof. Brun concludes that the elephant's tusk must have been a long time in fluviatile waters.

A THIRD mathematical tract (Invariants) for American students is now being written by Dr. W. J. Wright, recently Professor of Mathematics at Wilson College, Pa. The previous tracts, which we have noticed in these columns, bore the titles of Determinants, Trilinear Co-ordinates.

ON August 29, 1879, a century will have passed since Johann Jakob von Berzelius, the celebrated chemist, was born at Westerlösa, in Sweden. The Swedish papers draw attention to this fact, and request that preparations for a dignified celebration of that day should be made in good time.

WE have received three parts (containing the concluding chapters) of the second edition of Herr F. von Hauer's work, "Die Geologie und ihre Anwendung auf die Kenntniss der Bodenbeschaffenheit der oesterr. ungar. Monarchie" (Vienna, Hölder); also a German work, by Prof. F. Lorber, "On the Exactness of Measurements of Length."

THE investigations which have been carried on for more than ten years at the Hague, in order to find out the house which Spinoza inhabited from the year 1652 until the day of his death, on February 21, 1678, have at last been crowned with success.

It is now proved that the great philosopher occupied an attic in the house, No. 28, Paveljoens-gracht in Doublet Straat, opposite to the Holy Ghost House (hoffje). The house belonged to a Heer van der Spyk. Shortly a marble tablet with a fitting inscription will be placed over the entrance.

THE German Geological Society met at Göttingen in the last week of September. The first lecture was delivered by Prof. Credner, of Leipzig, who spoke on the granite of Geyer. Then Prof. Klein, of Göttingen, spoke on a collection of thin sections of minerals forming rocks.—Herr Levin presented a petrified starfish (*Asteria cilicia*) found by him in the upper Muschelkalk of the Hainberg. This specimen is particularly interesting, being the first starfish which has ever been found in the North German limestone.—A communication was read from Prof. Martin, of Leyden, on the tertiary fauna of Java.—Dr. Hornstein (Cassel) reported on a new treatise on Eozoon by Prof. Möbius (Kiel), which will be published in Parts 5 and 6 of the "Palæontographica." Prof. Möbius arrives at the conclusion, from long-continued investigations of numerous specimens of Eozoon, that the latter is of inorganic nature.—Then followed some minor communications from Herr von Groddeck, Prof. Streng, and Prof. Weiss (Berlin), the latter pointing to a recent discovery of coal in the so-called "Eherne Kammer," some few miles to the south of Eisenach. The other speakers at the meeting were Prof. von Seebach (Göttingen), Herren Grotrian (Brunswick), Römer (Breslau), Schmid (Jena), and Prof. vom Rath (Bonn). The Society will meet at Baden Baden in 1879.

ACCORDING to a communication made at the Berlin meeting of ornithologists by Dr. Brehm, the Crown Prince Rudolf of Austria is about to publish a work on Eagles, in conjunction with Drs. Brehm and von Homeyer.

WE have on our table the following works:—"Commercial Products of the Sea," P. L. Simmonds (Griffith and Farran); "Talks about Plants," Mrs. Lankester (Griffith and Farran); "Notes on a Tour in America," H. Hussey Vivian (E. Stanford); "Philosophical Fragments," Dr. Morell (Longmans); "Geological Survey of Canada: Report of Progress for 1876 and 1877," "The Germ Theories of Infectious Diseases," J. Drysdale, M.D. (Baillière); "Sedimentary Formation of New South Wales," Rev. W. B. Clarke (Trübner); "Annual Report of the Department of Mines of New South Wales for 1877" (Trübner); "Australian Orchids," Parts 3 and 4, R. D. Fitzgerald (Trübner); "Geology of Ireland," G. H. Kinahan (Kegan Paul, and Co.); "Animal Chemistry," C. H. Kingzett (Longmans); "Manuel du Voyageur," D. Kaltbrunner (Würster and Co., Zurich); "Report on the Geological Survey of the United States," Dr. Hayden.

THE additions to the Zoological Society's Gardens during the past week include a Squirrel Monkey (*Saimaris sciurea*), from Guiana, presented by Mr. Edward Calthrop; an Emu (*Dromæus novæ-hollandiæ*), from Australia, presented by Mr. C. Hampden Wigram; two Radiated Tortoises (*Testudo radiata*), from Madagascar, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Water Rail (*Rallus aquaticus*), British Isles, presented by Capt. F. H. Salvin; a Michie's Tufted Deer (*Elaphodus cephalophus*), from China; a Naked-throated Bell-bird (*Chasmorhynchus nudicollis*); three Blue-bearded Jays (*Cyanocorax cyanopogon*); a Dark-winged Buzzard (*Leucopternis scotopterus*), from Bahia; a Saturnine Mocking Bird (*Mimus saturninus*); two Lined Finches (*Spermophila lineola*); two Gutteral Finches (*Spermophila gutteralis*), from Pernambuco; a Pileated Song Sparrow (*Zonotrichia pileata*), from Rio de Janeiro; a Palm Tanager (*Tanagra palmarum*), from Monte Video, deposited; a Patas Monkey (*Cercopithecus ruber*), from West Africa; two Ruddy Sheldrakes (*Tadorna rutila*), European, purchased.

ON A NEW METHOD OF STUDYING THE OPTICAL CHARACTERS OF MINERALS[1]

AS is well known, the optical characters of minerals furnish us with a most valuable means for identifying the various species. The practical application of these phenomena has, however, been much restricted by the difficulty of obtaining crystals sufficiently large and transparent to be cut into appropriate sections, so that the properties of some of the commonest minerals were very imperfectly known. By the methods hitherto employed it was almost impossible to study the black or imperfectly transparent minerals constituting the chief part of rock masses, and in fact little could be learned unless the specimens were so large and perfect that the individual species could be identified by other means. What we want is a method which will enable us to ascertain the approximate value of the principal optical constants, when we have at our disposal only detached, small, and imperfect crystals in their natural state, or those scattered about in thin sections of rocks, cut into plates which are inclined at every varying angle to the optic axes.

The method now to be described satisfies these requirements sufficiently well. Time would not permit me to give a full description of the apparatus, the manner of using it, and the conclusions to be drawn from the observed data. I must therefore avoid all unnecessary detail, and confine myself to such an outline as will serve to indicate the general character of the method. I may here say that I have received most valuable assistance from Prof. Stokes in the mathematical part of the subject.

When, many years ago, I first commenced to apply the microscope to the study of minerals, I was told by a well-known professor of mineralogy that it would never be possible to learn much by the use of that instrument. If we merely magnify a portion of a pure transparent crystal, we do, indeed learn little or nothing; but if, instead of viewing the crystal itself, we look through it with a suitable magnifying power at some appropriate object, we can learn more facts of interest and importance than by any other single method whatever. The property possessed by the object-glass of collecting divergent rays to form an image gives rise to an entirely new class of phenomena, and converts the microscope into a most valuable apparatus for optical research. The object examined through the crystals is the image of a small circular hole, or of rectangular lines ruled on a piece of glass, formed at the focal point of a well-corrected achromatic condenser fixed below the stage, and so arranged that the image is placed either just below or just above the lower surface of the crystal. The divergent rays passing through it to the object-glass are bent so that the focal length is, as it were, increased by an amount depending on the thickness of the crystal and its refractive power. In order to see the lines in focus, it is therefore necessary to move back the body of the microscope. If we know the thickness (T) and the amount of the displacement of the focal length (d), we can calculate the value of the index of refraction (μ) from the equation

$$\mu = \frac{T}{T - d}.$$

These values are measured by means of a scale and vernier attached to the body of the microscope; and, with care, there ought to be no error greater than $\frac{1}{2000}$th of an inch. The thickness of the specimen (T) is determined by measuring the difference in the focal points for particles of dust on the surface of the supporting glass and on the upper surface of the mineral. In a similar manner the value of d is determined by the difference in the focal length for the lines of the grating seen through the supporting glass with or without the specimen under examination. From the value of the index thus determined a small amount must be deducted, depending upon the aperture and correction of the object-glass, and, when great accuracy is desired, several precautions must be taken to avoid a number of possible small errors, which it would be tedious to explain in detail.

In the equation, $\mu = \frac{T}{T - d}$, it is assumed that the substance possesses no double refraction, as in the case of glass or crystals belonging to the regular system. When viewed through such a substance, only one simple and undistorted image of the circular hole can be seen, and both sets of lines are in focus at the same

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[1] Address by the Chairman, H. C Sorby, F.R.S., Pres. G.S., &c., at the meeting of the Yorkshire Geological and Polytechnic Society, held in Selby on March 13.